



HOW MUCH DOES A CROP REMOVE

FACT SHEET

Often times we get asked how do we make a recommendation and what does a crop actually remove in the way of nutrients from the soil in a cropping year. A soil test measures the available nutrients in the soil over the growing season and the recommendations are guidelines for crop input based on the levels of available nutrients found and yield goal. Soil researchers and Plant Physiologists have extensively documented years of research in both the areas of optimum soil levels for plant growth and how much is removed by a crop in a production year.

A & L International's system for making recommendations is based on world wide soil calibration research information that has determined what is required to produce a unit of finished product. When A & L makes a recommendation we use the latest information available to come up with a recommendation guide for the amount of plant food per acre that will be required to replace what the crop will remove. Plus a build factor to bring the soil to optimum levels over time. By bringing the soil levels to optimum nutrient status the consistency of having a good production year after year will improve.

It is understood that the nutrient removed from a soil in production of any crop is in two areas. One area is in the grain or harvested portion of the crop that will be removed from the field and the other is the nutrients that are contained in the straw and residue that is returned to the field. However this second portion is not immediately available after it is returned to the soil as it is tied up in the organic portion of the crop residue and needs to decompose before it is returned and made available to the plant. In some cases such as straw, additional nutrients may be required to break down the portion returned. A proper soil test program will monitor the release of these nutrients and the rate of decomposition will vary depending on a number of factors.

Therefore, each year we need to account for all the nutrients that are required to grow the crop relying on a soil test to establish and track soils levels over time. The following tables and calculations will explain how recommendations are made.

Table #1 lists the amount of nutrients required to grow these crops each cropping year. As soybeans produce about 50% of their own N by rhizobia they only require a portion to be supplied from other sources. The other nutrients however must be replenished or the crop will consequently continue to mine them from the soil and over time production and quality will suffer.

Table #2 is some of the optimum soil K levels that have been established by soil researchers across North America and are adopted by A&L as a reference when making a recommendation. As with all nutrients, if the soil levels are not at optimum we recommend building these soils. If the soils are at optimum levels the recommendation program only requires that amount we are removing or a maintenance amount.

Often times we hear people refer to the soils natural ability to replenish nutrients that are removed by crop production. This is the amount of nutrients contained in the soils that are not available to the plant. Each year a portion of these nutrients will become available as soils weather and every soil will have a base amount that its levels will never drop below due to its ability to replenish these resources. However if a soil is at this base amount it is at "ROCK BOTTOM" and will not provide nutrients to a growing crop consistently. Therefore we need to establish the optimum levels for these soils and build the nutrient reserves to these levels.

TABLE #1

NUTRIENT REMOVAL IN A 3 YEAR ROTATION SYSTEM

NUTRIENTS REMOVED LBS/ACRE							
CROP ROTATION	Yield	N	P	K	Mg	Ca	S
1 ST YEAR CORN	120	180	72	156	24	25	19
2 ND YEAR BEANS	50	275	60	120	23	85	23
3 RD YEAR WHEAT	80	168	58	128	19	21	18

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TABLE #2

		OPTIMUM SOIL K LEVELS PPM					
		C.E.C.					
		<5	5.1-9.9	10-12.9	13-14.9	15-17.9	18-20.9
CORN	120 BU	133	149	160	166	174	184
BEANS	50 BU	111	124	133	138	145	153
WHEAT	80 BU	111	124	133	138	145	153
		OPTIMUM P LEVELS PPM					
		<5	5.1-9.9	10-12.9	13.14-9	15-17.9	18-20.9
		80	70	60	40	35	30

To calculate the amount of “K” to apply we use the following formula:

$$(\text{optimum K level} - \text{soil test value}) \times 2 + \text{maintenance factor} = \text{lbs/ac K to apply}$$

In order to make a recommendation for “P” we will use the information provided from various researches that it takes approximately 4-10 pounds of P₂O₅ to raise a soil test level 1 ppm. This is only provided that there is no crop removing any P. If P is being removed we must also consider that amount in our recommendation. Because all soils vary we will use an average figure for P building of 5lbs P₂O₅ and depend on a soil test taken every 2-3 years to monitor building rates. Table #3 gives an optimum P level based on CEC that we will use to determine target values.

When making a recommendation for a crop under a rotation system it is a must we include a specific recommendation that will address the amount that each crop will remove. The following are examples of two different soils. Sample #1 would be considered at optimum levels and Sample #2 is a soil that requires some additional fertilizer nutrients to build it to optimum levels.

In these samples for example we will target the optimum “K” level at 166 for corn and 138 for the beans and wheat. The optimum level for “P” we will target as 35 moving the soil into a medium level of fertility of “P” over a three-year period.

OPTIMUM PHOSPHORUS LEVELS BASED ON CEC

CEC	0-6	7-15	16-25	25+
MEDIUM	26-55	24-43	19-33	14-23
GOOD	56-93	44-83	34-55	24-43

A soil test done every 2 to 3 years will monitor if the build program is sufficient for this soil type or will need to be modified.

Table #3

	Maintenance Factors	
	K	P
CORN	.25	.35
BEANS	1.4	.9
WHEAT	.5	.6

FORMULA FOR CALCULATING NITROGEN

Corn $1.45 \times \text{Yield Goal} - (10 \times \% \text{O.M.}) + \text{or} - \text{Previous crop Nitrogen credit}$

Winter Wheat $1.5 \times \text{Yield Goal} - (5 \times \% \text{O.M.}) + \text{or} - \text{Previous crop Nitrogen credit}$

Previous crop Nitrogen credit; Corn + 20, Wheat + 20, Beans - 10

EXAMPLE SAMPLE #1: CEC 15 and % optimum		N	P	K	Organic Matter 3.5 All nutrient levels at
	Corn	120 bu	159	40	30
	Beans	50 bu	20	45	70
	Wheat	80 bu	120	50	40

EXAMPLE #2: CEC 15 and % Organic Matter 3.5, K levels at 120, P levels at 20 ppm.

P build = (desired test - soil test) x 5

$(35-20) \times 5 = 75$ pounds P_2O_5 over three years = $75/3 = 25$ pounds of P_2O_5 to be added each year for build.

Removal = Yield goal x Maintenance

**P Recommendations:
Build + Removal**

**CORN = $25 + 40 = 65$ pounds P
BEANS = $25 + 45 = 70$ pounds P
WHEAT = $25 + 48 = 73$ pounds P**

K Recommendations: For optimum soil K levels see Table #2 . To Calculate K recommendations use the following formula

$(\text{optimum K level} - \text{soil test value}) \times 2 + \text{maintenance factor} = \text{lbs/ac K to apply}$

**CORN = $(166-120) \times 2 + 30 = 122$ lbs
BEANS = $(138-120) \times 2 + 70 = 106$ lbs
WHEAT = $(138-120) \times 2 + 40 = 76$ lbs**

Recommendations		N	P	K
	CORN	159	65	122
	BEANS	20	70	106
	WHEAT	120	73	76